General

Guideline Title

Guidelines for the acute medical management of severe traumatic brain injury in infants, children, and adolescents - second edition.

Bibliographic Source(s)

Kochanek PM, Carney N, Adelson PD, Ashwal S, Bell MJ, Bratton S, Carson S, Chesnut RM, Ghajar J, Goldstein B, Grant GA, Kissoon N, Peterson K, Selden NR, Tasker RC, Tong KA, Vavilala MS, Wainwright MS, Warden CR, American Academy of Pediatrics-Section on Neurological Surgery, American Association of Neurological Surgeons/Congress of Neurological Surgeons, Child Neurology Society, European Society of Pediatric and Neonatal Intensive Care, Neurocritical Care Society, Pediatric Neurocritical Care Research Group, Society of Critical Care Medicine, Paediatric Intensive Care Society UK, Society for Neuroscience in Anesthesiology and Critical Care, World Federation of Pediatric Intensive and Critical Care Societies. Guidelines for the acute medical management of severe traumatic brain injury in infants, children, and adolescents--second edition. Pediatr Crit Care Med. 2012 Jan;13(Suppl 1):S1-82. [381 references] PubMed

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

The class of evidence (I, II, III) and strength of the recommendations (strong, weak) are defined at the end of the "Major Recommendations" field.

Indications for Intracranial Pressure Monitoring

Strength of Recommendations: Weak.

Quality of Evidence: Low, from poor and moderate-quality class III studies.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: Use of intracranial pressure (ICP) monitoring may be considered in infants and children with severe traumatic brain injury (TBI).

Threshold for Treatment of Intracranial Hypertension

Strength of Recommendations: Weak.

Quality of Evidence: Low, from poor-quality class III studies.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: Treatment of ICP may be considered at a threshold of 20 mm Hg.

Cerebral Perfusion Pressure Thresholds

Strength of Recommendations: Weak.

Quality of Evidence: Low, from poor- and moderate-quality class III studies.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: A minimum cerebral perfusion pressure (CPP) of 40 mm Hg may be considered in children with TBI.

A cerebral perfusion pressure threshold 40-50 mm Hg may be considered. There may be age-specific thresholds with infants at the lower end and adolescents at the upper end of this range.

Advanced Neuromonitoring

Strength of Recommendation: Weak.

Quality of Evidence: Low, from one moderate- and one poor-quality class III study.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: If brain oxygenation monitoring is used, maintenance of partial pressure of brain tissue oxygen ($PbtO_2$) ≥10 mm Hg may be considered.

Neuroimaging

Strength of Recommendation: Weak.

Quality of Evidence: Low from one poor-quality class III study.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: In the absence of neurologic deterioration or increasing ICP, obtaining a routine repeat computed tomography (CT) scan >24 hrs after the admission and initial follow-up study may not be indicated for decisions about neurosurgical intervention.

Hyperosmolar Therapy

Strength of Recommendations: Weak.

Quality of Evidence: Moderate, based on two moderate-quality class II studies and one poor-quality class III study.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: Hypertonic saline should be considered for the treatment of severe pediatric TBI associated with intracranial hypertension. Effective doses for acute use range between 6.5 and 10 mL/kg.

Level III*: Hypertonic saline should be considered for the treatment of severe pediatric TBI associated with intracranial hypertension. Effective doses as a continuous infusion of 3% saline range between 0.1 and 1.0 mL/kg of body weight per hour administered on a sliding scale. The minimum dose needed to maintain ICP <20 mm Hg should be used. Serum osmolarity should be maintained <360 mOsm/L.

*Although mannitol is commonly used in the management of raised ICP in pediatric TBI, no studies meeting inclusion criteria were identified for use as evidence for this topic.

Temperature Control

Strength of Recommendations: Weak.

Quality of Evidence: Moderate, from class II and III studies with some contradictory findings.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: Moderate hypothermia (32–33°C) beginning early after severe TBI for only 24 hrs' duration should be avoided.

Moderate hypothermia (32–33°C) beginning within 8 hrs after severe TBI for up to 48 hrs' duration should be considered to reduce intracranial hypertension.

If hypothermia is induced for any indication, rewarming at a rate of >0.5°C/hr should be avoided.

Level III*: Moderate hypothermia (32–33°C) beginning early after severe TBI for 48 hrs, duration may be considered.

*After completion of these guidelines, the committee became aware that the *Cool Kids* trial of hypothermia in pediatric TBI was stopped because of futility. The implications of this development on the recommendations in this section may need to be considered by the treating physician when details of the study are published.

Cerebrospinal Fluid Drainage

Strength of Recommendations: Weak.

Quality of Evidence: Low from poor-and moderate-quality class III studies with some contradictory findings.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: Cerebrospinal fluid (CSF) drainage through an external ventricular drain may be considered in the management of increased ICP in children with severe TBI.

The addition of a lumbar drain may be considered in the case of refractory intracranial hypertension with a functioning external ventricular drain, open basal cisterns, and no evidence of a mass lesion or shift on imaging studies.

Barbiturates

Strength of Recommendation: Weak.

Quality of Evidence: Low from poor-quality class III studies.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: High-dose barbiturate therapy may be considered in hemodynamically stable patients with refractory intracranial hypertension despite maximal medical and surgical management.

When high-dose barbiturate therapy is used to treat refractory intracranial hypertension, continuous arterial blood pressure monitoring and cardiovascular support to maintain adequate cerebral perfusion pressure are required.

Decompressive Craniectomy for the Treatment of Intracranial Hypertension

Strength of Recommendations: Weak.

Quality of Evidence: Low, from poor and moderate-quality class III studies.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: Decompressive craniectomy (DC) with duraplasty, leaving the bone flap out, may be considered for pediatric patients with TBI who are showing early signs of neurologic deterioration or herniation or are developing intracranial hypertension refractory to medical management during

the early stages of their treatment.

Hyperventilation

Strength of Recommendations: Weak.

Quality of Evidence: Low, from one poor-quality study and one moderate-quality class III study.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: Avoidance of prophylactic severe hyperventilation to a carbon dioxide partial pressure ($PaCO_2$) <30 mm Hg may be considered in the initial 48 hrs after injury.

If hyperventilation is used in the management of refractory intracranial hypertension, advanced neuromonitoring for evaluation of cerebral ischemia may be considered.

Corticosteroids

Strength of the Recommendation: Weak.

Quality of the Evidence: Low, from two reports of one small, moderate-quality class II study.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: The use of corticosteroids is not recommended to improve outcome or reduce ICP for children with severe TBI.

Level III: There are insufficient data to support a level III recommendation for this topic.

Analgesics, Sedatives, and Neuromuscular Blockade

Strength of Recommendations: Weak.

Quality of Evidence: Low, from poor-quality class III studies.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III*: Etomidate may be considered to control severe intracranial hypertension; however, the risks resulting from adrenal suppression must be considered.

Thiopental may be considered to control intracranial hypertension.

*In the absence of outcome data, the specific indications, choice and dosing of analgesics, sedatives, and neuromuscular-blocking agents used in the management of infants and children with severe TBI should be left to the treating physician.

*As stated by the Food and Drug Administration, continuous infusion of propofol for either sedation or the management of refractory intracranial hypertension in infants and children with severe TBI is not recommended.

Glucose and Nutrition

Strength of the Recommendation: Weak.

Quality of Evidence: Moderate, from one moderate-quality class II study.

Level 1: There are insufficient data to support a level I recommendation for this topic.

Level II: The evidence does not support the use of an immune-modulating diet for the treatment of severe TBI to improve outcome.

Level III: In the absence of outcome data, the specific approach to glycemic control in the management of infants and children with severe TBI should be left to the treating physician.

Antiseizure Prophylaxis

Strength of Recommendation: Weak.

Quality of Evidence: Low, from one poor-quality class III study.

Level I: There are insufficient data to support a level I recommendation for this topic.

Level II: There are insufficient data to support a level II recommendation for this topic.

Level III: Prophylactic treatment with phenytoin may be considered to reduce the incidence of early posttraumatic seizures (PTS) in pediatric patients with severe TBI.

Definitions:

Classification of Evidence

Class of Evidence	Study Design	Quality Criteria
I	Good-quality randomized controlled trial (RCT)	Adequate random assignment method Allocation concealment Groups similar at baseline Outcome assessors blinded Adequate sample size Intention-to-treat analysis Follow-up rate ≥85% No differential loss to follow-up Maintenance of comparable groups
II	Moderate or poor-quality RCT	Violation of one or more of the criteria for a good quality RCT[a]
II	Good-quality cohort	Blind or independent assessment in a prospective study or use of reliable[b] data in a retrospective study Comparison of two or more groups must be clearly distinguished Nonbiased selection Follow-up rate ≥85% Adequate sample size Statistical analysis of potential confounders[c]
II	Good-quality case-control	Accurate ascertainment of cases Nonbiased selection of cases/controls with exclusion criteria applied equally to both Adequate response rate Appropriate attention to potential confounding variables
III	Moderate or poor-quality RCT or cohort	Violation of one or more criteria for a good-quality RCT or cohort[a]
III	Moderate or poor-quality case-control	Violation of one or more criteria for a good-quality case control[a]
III	Case series, databases, or registries	Prospective collected data that are purely observational and retrospectively collected data

[a]Assessor needs to make a judgment about whether one or more violations are sufficient to downgrade the class of study based on the topic, the seriousness of the violation(s), their potential impact on the results, and other aspects of the study. Two or three violations do not necessarily constitute a major flaw. The assessor needs to make a coherent argument why the violation(s) either do, or do not, warrant a downgrade; [b]reliable data are concrete data such as mortality or reoperation; [c]publication authors must provide a description of robust baseline characteristics and control for those that are unequally distributed between treatment groups.

Strength of Recommendations

Strong: derived from high-quality evidence that provides precise estimates of the benefits or downsides of the topic being assessed.

With weak recommendations, (1) there is lack of confidence that the benefits outweigh the downsides, (2) the benefits and downsides may be equal, and/or (3) there is uncertainty about the degree of benefits and downsides.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Severe traumatic brain injury

Guideline Category

Management

Treatment

Clinical Specialty

Anesthesiology

Critical Care

Neurological Surgery

Neurology

Pediatrics

Radiology

Intended Users

Physicians

Guideline Objective(s)

To provide recommendations for the acute medical management of severe traumatic brain injury in infants, children, and adolescents

Target Population

Infants, children, and adolescents with severe traumatic brain injury

Interventions and Practices Considered

1. Intracranial pressure (ICP) monitoring
2. Threshold for intracranial hypertension treatment
3. Cerebral perfusion pressure (CPP) thresholds
4. Brain oxygenation monitoring and maintenance of brain tissue oxygenation
5. Computed tomography (CT) (repeat CT not recommended in the absence of neurologic deterioration or increasing ICP)
6. Use of hypertonic saline in cases of intracranial hypertension
7. Timing and duration of moderate hypothermia
8. Rewarming rate from induced hypothermia
9. Use of ventricular and lumbar cerebral spinal fluid (CSF) drainage
10. Use of high-dose barbiturates, as indicated, with continuous arterial blood pressure monitoring and cardiovascular support
11. Use of decompressive craniectomy with duraplasty, as indicated
12. Hyperventilation in cases of refractory intracranial hypertension, with advanced neuromonitoring, as indicated
13. Use of analgesics, sedatives, and neuromuscular-blocking agents (etomidate, thiopental, physician choice)
14. Glycemic control (specific approach left to the physician)
15. Use of phenytoin for antiseizure prophylaxis

Considered but not recommended:

1. Use of corticosteroids
2. Propofol for either sedation or the management of refractory intracranial hypertension
3. Use of immune-modulating diet

Major Outcomes Considered

- Morbidity and mortality rates
- Functional outcome
- Change in intracranial pressure
- Duration of stay in the intensive care unit

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search and Retrieval

Center staff worked with a doctoral-level research librarian to construct electronic search strategies for each topic (see Appendix B in the original guideline document). For new topics, the literature was searched from 1950 to 2009 and for previous topics from 1996 to 2009. A second search was conducted for 2009–2010 to capture any new relevant literature. Strategies with the highest likelihood of capturing most of the targeted literature were used, which resulted in the acquisition of a large proportion of nonrelevant citations.

Two contributing authors (coauthors) were assigned to each topic, and a set of abstracts was sent to each coauthor. Blinded to each other's work, they read the abstracts and eliminated citations using the prespecified inclusion/exclusion criteria. Center staff compared the coauthors' selections and identified and resolved discrepancies either through consensus or through use of a third reviewer. A set of full-text publications was then sent to each coauthor. Again blinded to each other's work, they read the publications and selected those that met the inclusion criteria.

Results of the electronic searches were supplemented by recommendations of peers and by reading reference lists of included studies. Relevant

publications were added to those from the original search, constituting the final library of studies that were used as evidence in this document. The yield of literature from each phase of the search is presented in Appendix C in the original guideline document.

Study Selection

Inclusion Criteria

Inclusion criteria consisted of severe traumatic brain injury (Glasgow Coma Scale score <9); human subjects; English language publications; pediatric patients (age ≤18 yrs); randomized controlled trials (N ≥25); cohort studies, prospective or retrospective (N ≥25); case–control studies (N ≥25); and case series (N ≥5).

The intervention (independent variable) must be specific to the topic.

The outcome must be a relevant health outcome (morbidity or mortality) or a surrogate outcome that associates with a health outcome.

Minimum sample sizes were identified to circumscribe the body of literature and manage the scope of the project. There is no evidence that the selected cutoffs associate with levels of confidence in the reported results.

Exclusion Criteria

Exclusion criteria consisted of penetrating brain injury; animal studies; cadaver studies; non-English language publications; and adult patients (age >18 yrs).

Also excluded were studies in which the sample contained >15% of adult patients or >15% of patients with pathologies other than traumatic brain injury without separate analysis (see Appendix D in the original guideline document).

Case studies/editorials/comments/letters were excluded.

For each topic, relevant information from the *Guidelines for the Management of Severe Traumatic Brain Injury*) is reviewed. The panel agreed that data from the adult guidelines would not be used to contribute to recommendations for this document.

Additional details about the inclusion of direct and indirect evidence is contained in the original guideline document.

Number of Source Documents

70 articles were included

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Classification of Evidence

Class of Evidence	Study Design	Quality Criteria
I	Good-quality randomized controlled trial (RCT)	Adequate random assignment method Allocation concealment Groups similar at baseline Outcome assessors blinded Adequate sample size Intention-to-treat analysis Follow-up rate ≥85% No differential loss to follow-up Maintenance of comparable groups

Class of Evidence	Study Design	Quality Criteria
II	Moderate or poor-quality RCT	Violation of one or more of the criteria for a good quality RCT[a]
II	Good-quality cohort	Blind or independent assessment in a prospective study or use of reliable[b] data in a retrospective study Comparison of two or more groups must be clearly distinguished Nonbiased selection Follow-up rate ≥85% Adequate sample size Statistical analysis of potential confounders[c]
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[a]Assessor needs to make a judgment about whether one or more violations are sufficient to downgrade the class of study based on the topic, the seriousness of the violation(s), their potential impact on the results, and other aspects of the study. Two or three violations do not necessarily constitute a major flaw. The assessor needs to make a coherent argument why the violation(s) either do, or do not, warrant a downgrade; [b]reliable data are concrete data such as mortality or reoperation; [c]publication authors must provide a description of robust baseline characteristics and control for those that are unequally distributed between treatment groups.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Data Abstraction and Synthesis

Remaining blinded, coauthors read each publication and abstracted data using an evidence table template (see Appendix E in the original guideline document). They compared results of their data abstraction and through consensus finalized the data tables that constitute the evidence on which the recommendations are based. As a result of heterogeneity of studies within topics, and the lack of literature of adequate quality, data were not combined quantitatively.

Quality Assessment of Individual Studies and Classification of Evidence

In April of 2004, the BTF established a formal collaboration with the Evidence-Based Practice Center from Oregon Health & Science University. Center staff worked with two Evidence-Based Practice Center epidemiologists to develop criteria and procedures for the quality assessment of individual studies and classification of level of evidence provided by each included study. These criteria are designed to assess risk of bias for individual studies based on study design and conduct. Criteria for classification of evidence are in the "Rating Scheme for the Strength of the Evidence" field and are derived from criteria developed by the United States Preventive Services Task Force, the National Health Service Centre for Reviews and Dissemination (United Kingdom), and the Cochrane Collaboration. These criteria were used to assess the literature.

Three members of the Center staff, two of whom are Evidence-Based Practice Center epidemiologists, conducted all of the quality assessments. Two assessors, blinded to each other's work and to publication identification, read the selected studies and classified them as class I, II, or III. Discrepancies were resolved through consensus or through a third person's review.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

Coauthors drafted manuscripts for each topic. The entire team gathered for a 2-day work session to discuss the literature base and craft the recommendations. Manuscripts were revised. Virtual meetings were held with a subset of the coauthors to complete the editing process.

Rating Scheme for the Strength of the Recommendations

Strength of Recommendations

Strong: derived from high-quality evidence that provides precise estimates of the benefits or downsides of the topic being assessed.

With weak recommendations, (1) there is lack of confidence that the benefits outweigh the downsides, (2) the benefits and downsides may be equal, and/or (3) there is uncertainty about the degree of benefits and downsides.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

The final draft manuscript was circulated to the peer review panel and was revised incorporating selected peer review input.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate short-term management and treatment of pediatric patients with severe traumatic brain injury with better outcomes and lower mortality

Potential Harms

- Because of the long-term effects of computed tomography (CT) radiation exposure (lifetime risk of fatal cancer resulting from one head CT in a 1-yr-old child is as high as one in 1500), the neurosurgical decision to order a CT scan also should be considered a treatment decision, weighing the knowledge gained against the risk of long-term radiation exposure.
- Cerebrospinal fluid (CSF) drainage may be associated with an increased risk of complications from hemorrhage and malpositioning.
- Cardiorespiratory side effects are very common and potentially toxic with barbiturate therapy, including decreased cardiac output, hypotension, and increased intrapulmonary shunt resulting in lower cerebral perfusion pressure and hypoxia. Thus, high-dose barbiturate therapy has been reserved for extreme cases of intracranial hypertension resistant to first-tier medical and surgical care.
- Arguing against the use of prophylactic hyperventilation, published evidence discussed in the guideline indicates that the use of hyperventilation is associated with cerebral blood flow (CBF) reductions and that prolonged and or significant hypocarbia is associated with poor outcome in pediatric patients with severe traumatic brain injury (TBI). As a result, advanced neuromonitoring for evaluation of cerebral ischemia may be considered if hyperventilation is to be used in the management of refractory intracranial hypertension.
- Analgesic or sedative-induced reductions in arterial blood pressure can lead to cerebral ischemia as well as vasodilation and can exacerbate increases in cerebral blood volume and intracranial pressure (ICP). In the absence of advanced neuromonitoring, care must be taken to avoid this complication.
- Risks of neuromuscular blockade include the potential devastating effect of hypoxemia secondary to inadvertent extubation, risks of masking seizures, increased incidence of nosocomial pneumonia (shown in adults with severe TBI), cardiovascular side effects, immobilization stress (if neuromuscular blockade is used without adequate sedation/analgesia), and increased intensive care unit (ICU) length of stay. Myopathy is most commonly seen with the combined use of nondepolarizing agents and corticosteroids. Incidence of this complication varies between 1% and over 30% of cases.
- Six hours after etomidate administration, adrenocorticotropic hormone stimulation tests were performed on each patient; four of the eight showed adrenal suppression. It is unclear if this degree of adrenal suppression is different from that normally observed in pediatric TBI. No patient showed clinical signs of adrenal insufficiency such as electrolyte disturbances or blood pressure lability, and no patient received steroid therapy.

Contraindications

Contraindications

- Coagulopathy (brain oxygenation) is a contraindication for neuromonitoring.
- The use of lumbar drainage is contraindicated in the setting of a focal mass lesion or shift.

Qualifying Statements

Qualifying Statements

The information contained in this Guidelines document reflects the current state of knowledge at the time of its completion, December 5, 2011. In view of the fact that there will be future developments in both scientific information and technology, it is anticipated that these Guidelines will be periodically reviewed and updated. These Guidelines are published and distributed with the understanding that the Brain Trauma Foundation and the other organizations that have collaborated and supported their development are not engaged in rendering professional medical services. If medical advice or assistance is required, the services of a competent physician should be sought. The recommendations contained in these Guidelines may not be appropriate for use in all circumstances. The decision to adopt any particular recommendation contained in these Guidelines must be made by a treating physician with knowledge of all of the facts and circumstances in each particular case and on the basis of the available resources.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Kochanek PM, Carney N, Adelson PD, Ashwal S, Bell MJ, Bratton S, Carson S, Chesnut RM, Ghajar J, Goldstein B, Grant GA, Kissoon N, Peterson K, Selden NR, Tasker RC, Tong KA, Vavilala MS, Wainwright MS, Warden CR, American Academy of Pediatrics-Section on Neurological Surgery, American Association of Neurological Surgeons/Congress of Neurological Surgeons, Child Neurology Society, European Society of Pediatric and Neonatal Intensive Care, Neurocritical Care Society, Pediatric Neurocritical Care Research Group, Society of Critical Care Medicine, Paediatric Intensive Care Society UK, Society for Neuroscience in Anesthesiology and Critical Care, World Federation of Pediatric Intensive and Critical Care Societies. Guidelines for the acute medical management of severe traumatic brain injury in infants, children, and adolescents--second edition. Pediatr Crit Care Med. 2012 Jan;13(Suppl 1):S1-82. [381 references] PubMed

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2012 Jan

Guideline Developer(s)

Brain Trauma Foundation - Disease Specific Society

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Guideline Committee

Not stated

Composition of Group That Authored the Guideline

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Financial Disclosures/Conflicts of Interest

Drs. Adelson, Kochanek and Vavilala have received funding from the National Institutes of Health. Dr. Chesnut has consulted for Integra and Innerspace in the past. Drs. Grant and Kochanek have received funding from the Department of Defense. The remaining authors have not disclosed any potential conflicts of interest.

Guideline Endorser(s)

American Academy of Pediatrics - Medical Specialty Society

American Association of Neurological Surgeons - Medical Specialty Society

Child Neurology Society - Medical Specialty Society

Congress of Neurological Surgeons - Professional Association

European Society of Paediatric and Neonatal Intensive Care - Nonprofit Organization

Neurocritical Care Society - Medical Specialty Society

Paediatric Intensive Care Society - Professional Association

Pediatric Neurocritical Care Research Group - Professional Association

Society for Neuroscience in Anesthesiology and Critical Care - Professional Association

Society of Critical Care Medicine - Professional Association

World Federation of Pediatric Intensive and Critical Care Societies - Nonprofit Organization

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) from the Brain Trauma Foundation Web site .

Print copies: Available from the Brain Trauma Foundation, 7 World Trade Center, 34th Floor, 250 Greenwich Street, New York, NY 10007; e-mail: btfinfo@braintrauma.org.

Availability of Companion Documents

None available

Patient Resources

None available

NGC Status

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